OAK RIDGE National Laboratory

Manufacturing Demonstration Facility

Data analytics framework for advanced manufacturing

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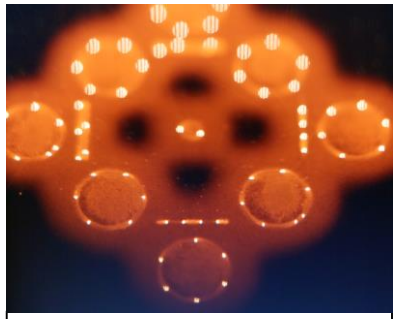
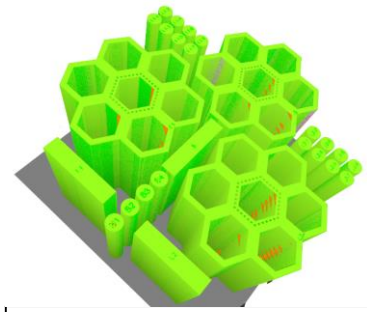
Digital platform for qualification and certification of advanced manufacturing processes

Rapid Prototyping



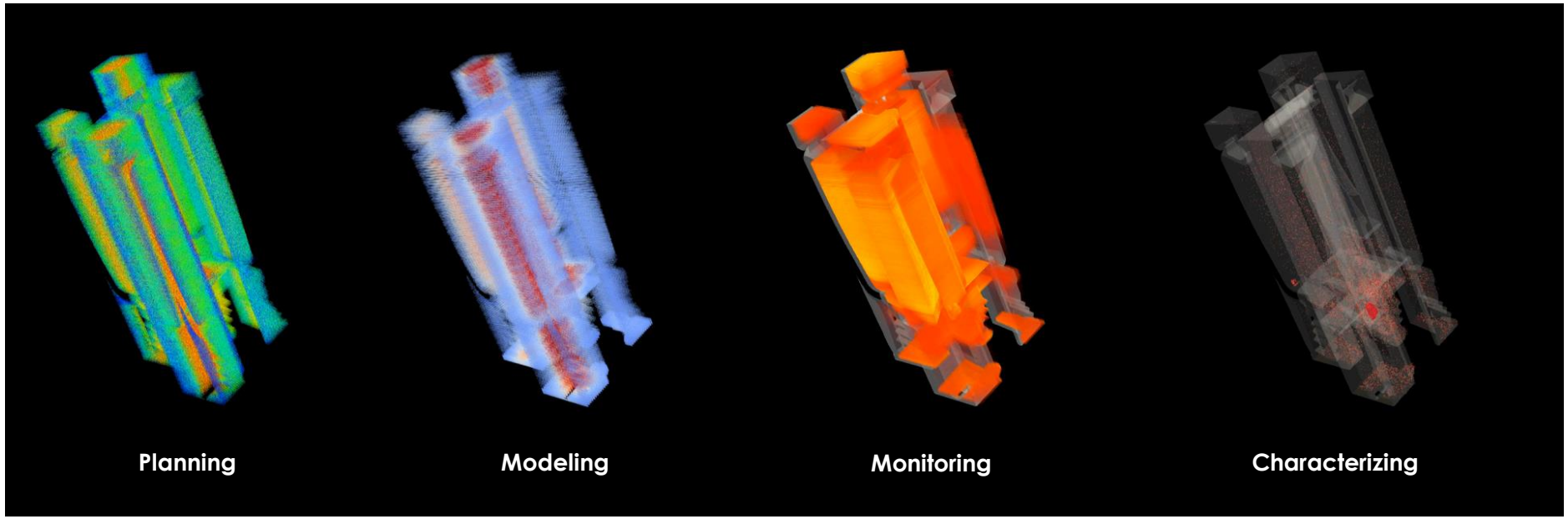
Sensors and IoT

Manufacturing Nuclear Reactors



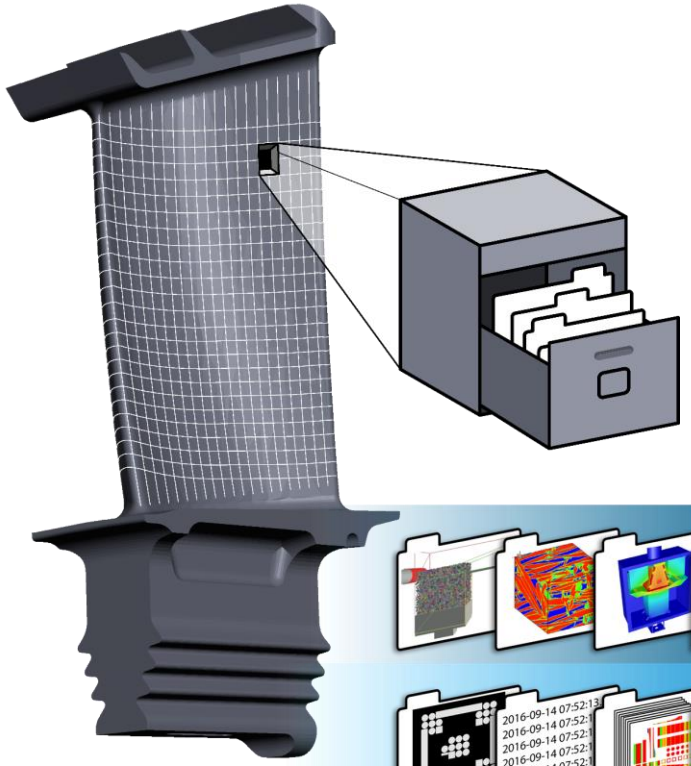
Data Analytics for Quality Control

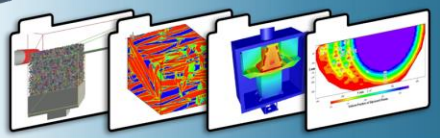
Education and Training



Driving the Next Materials Revolution

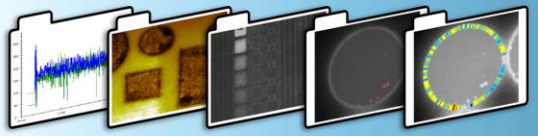
Creating a Framework for Coupling Data Analytics with Advanced Manufacturing



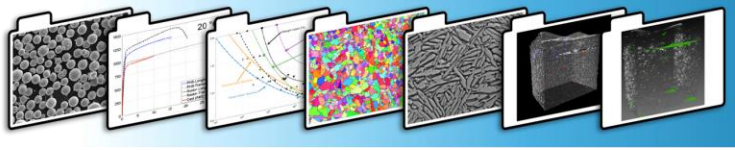


Modeling

Intent



In-Situ

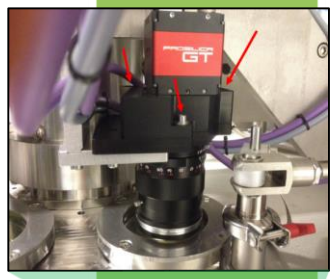


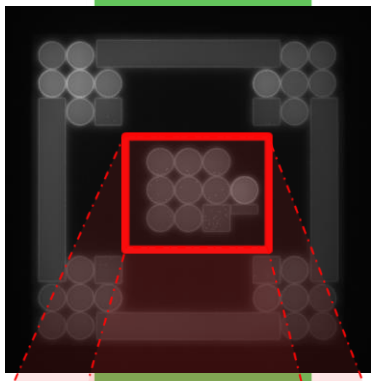
Ex-situ & Properties

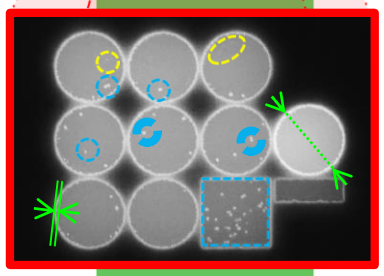
DREAM.3D
Open Source Edition

- Data Management & Tracking
- Signal Processing
- Computer Vision & Image Processing
- n-D Data Visualization
- Modeling & Simulation
- Data Analytics & Machine Learning
- Process Optimization
- Certification, Verification & Validation

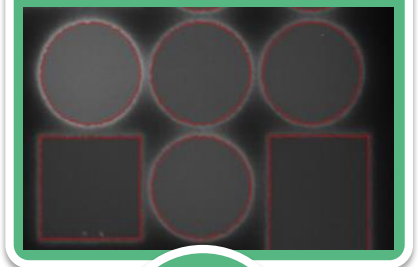
In-Situ Quality Control of AM Processes using AI





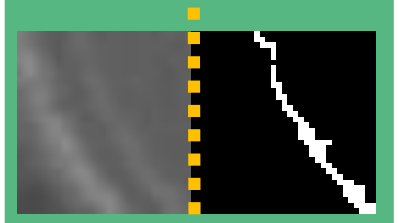


Edge detection



A.I.

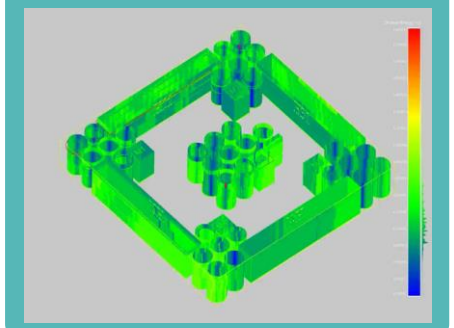
Porosity detection



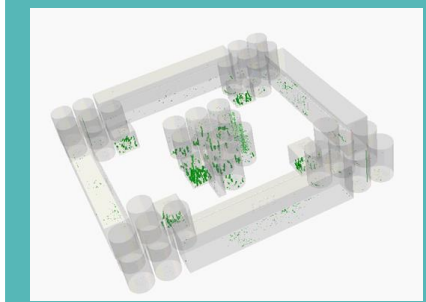
Source NIR image

Neural network results

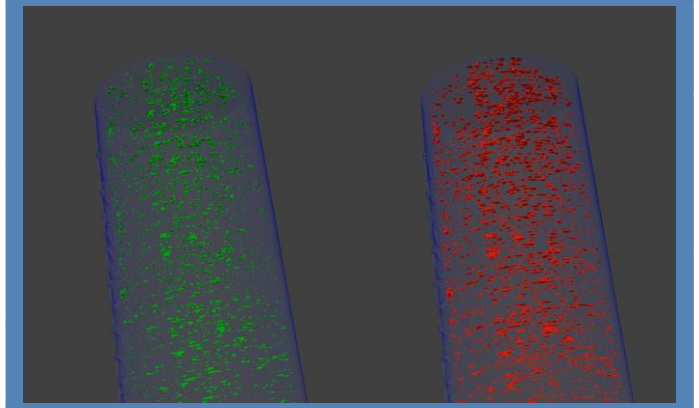
Geometric accuracy map



Defects 3D map



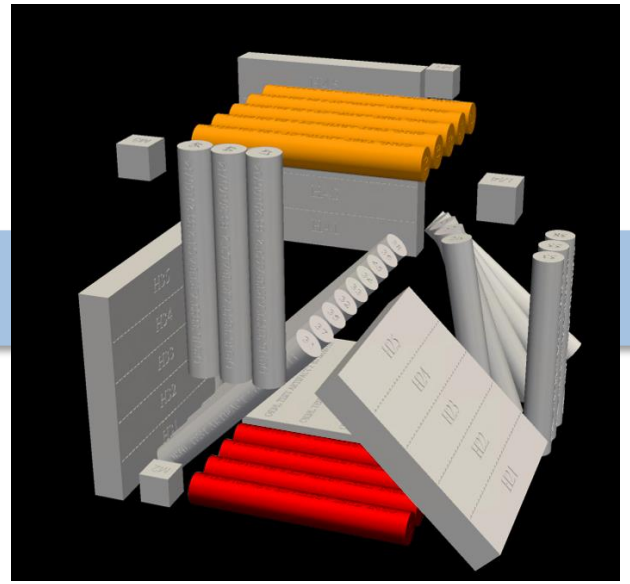
Comparison between ex-situ Computed Tomography and in-situ sensing

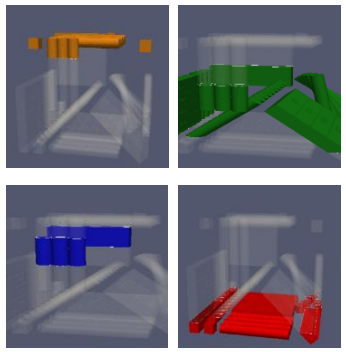


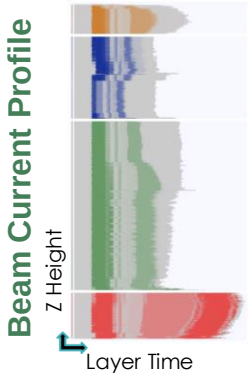
(left) 8um resolution CT vs. (right) 100um resolution in-situ

Instrumenting the AM Machines → Data Acquisition → AI / Machine Learning → Anomaly Detection → Real time results on par with traditional method

Achieving Uniform, Defect-Free Microstructures through Data Analytics and AI

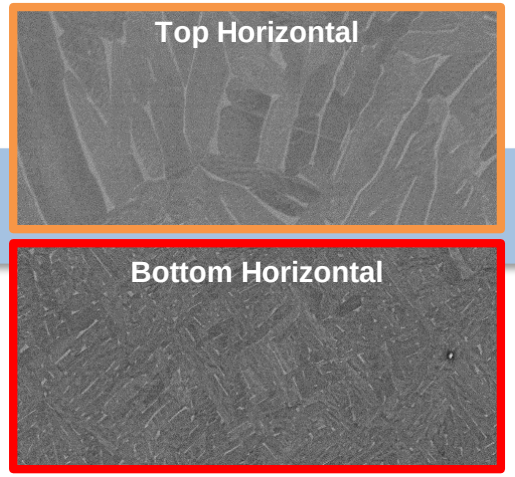


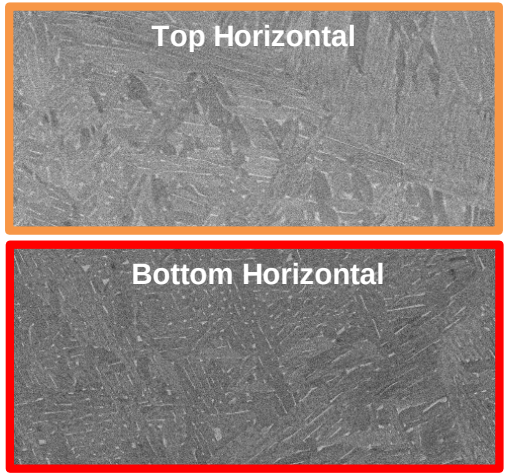




Geometry with varying cross section and printing time per layer

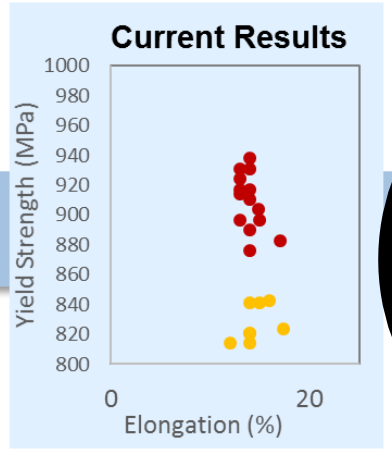
Micrographs Base Melt Theme

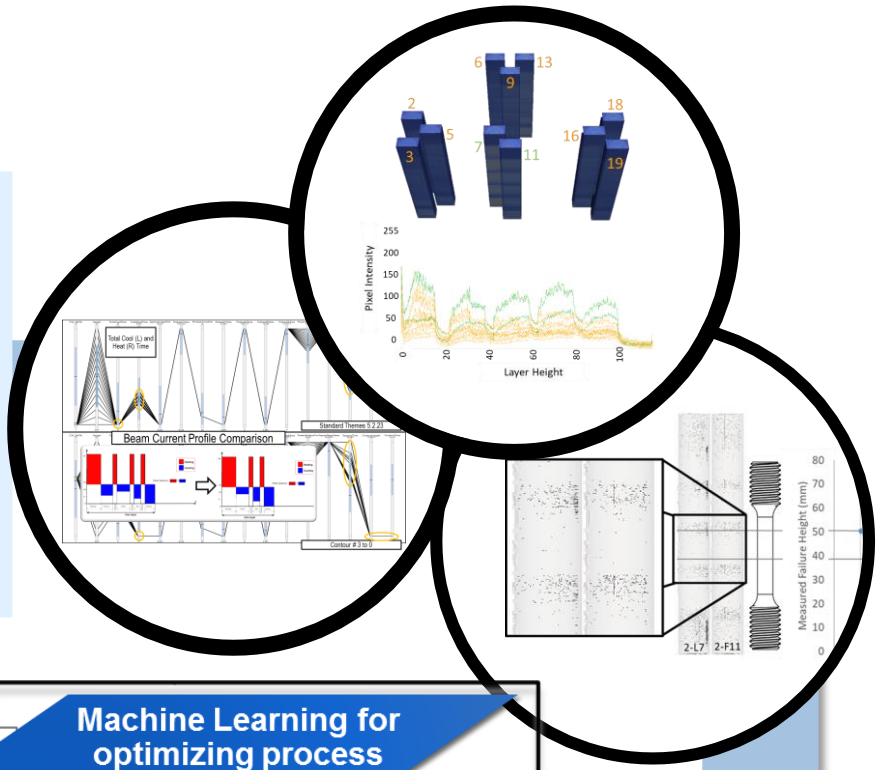


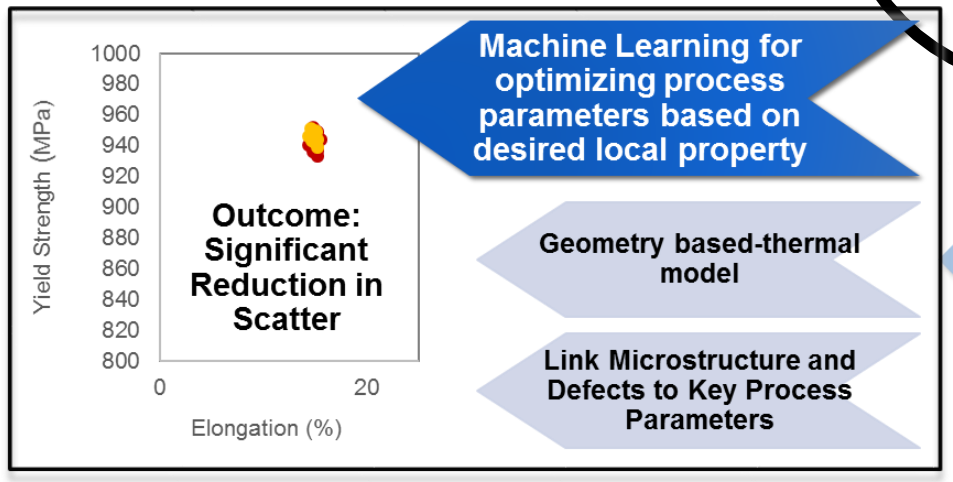


Micrographs Modified Melt Theme

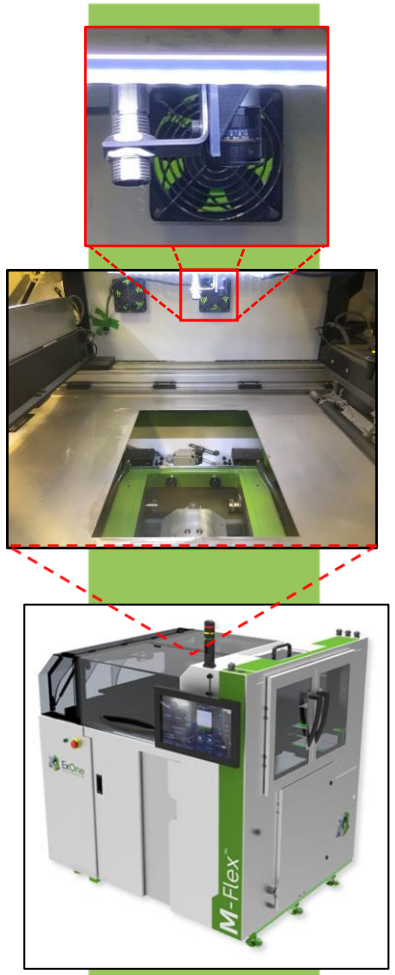
Scattered mechanical testing results

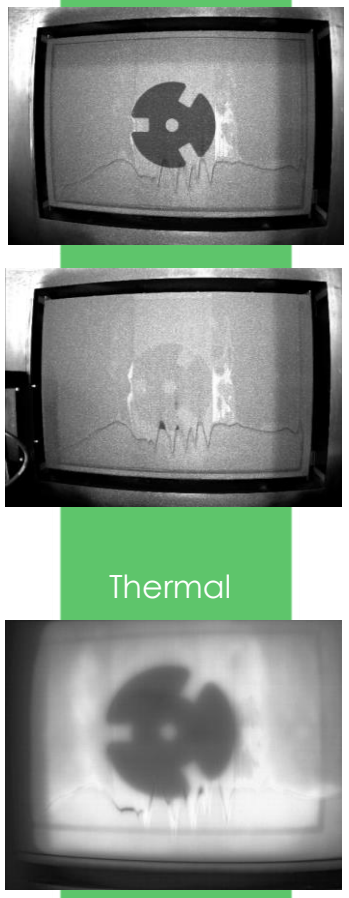


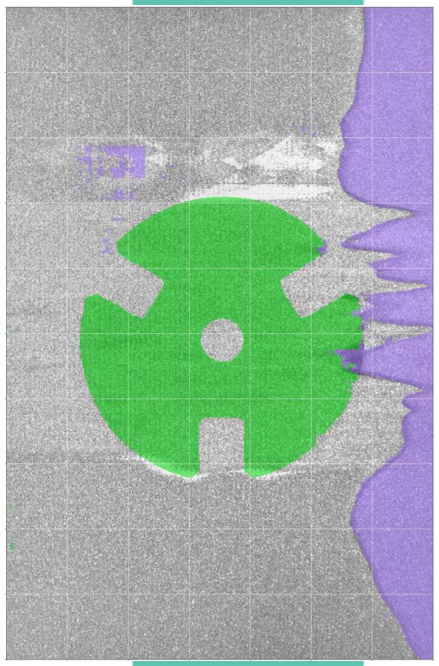


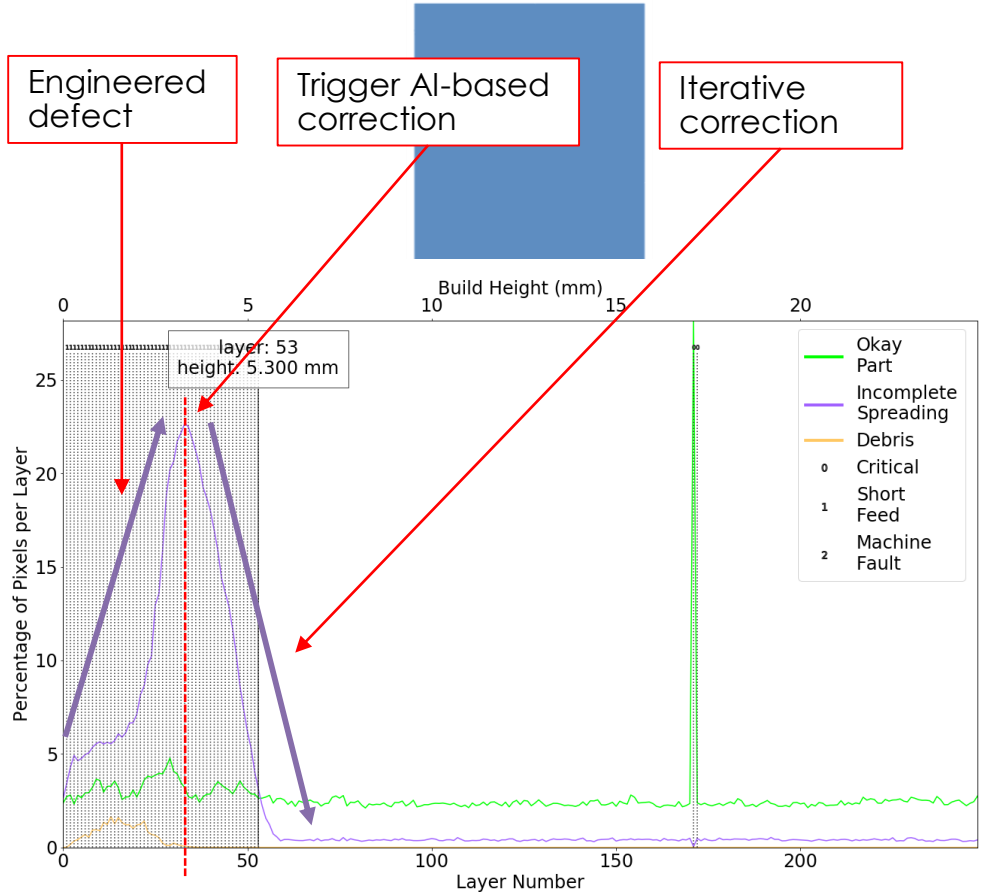


BinderJet: AI based defect detection and correction









ExOne M-Flex equipped with in-situ sensing

In-situ imaging modalities: visible and infrared

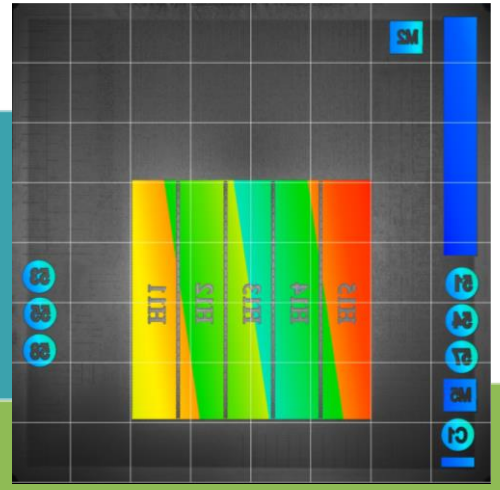
AI-based defect detection

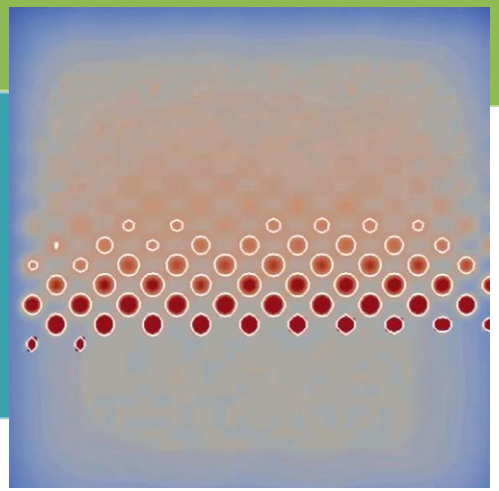
Implementation of an AI-based feedback loop control for defect correction

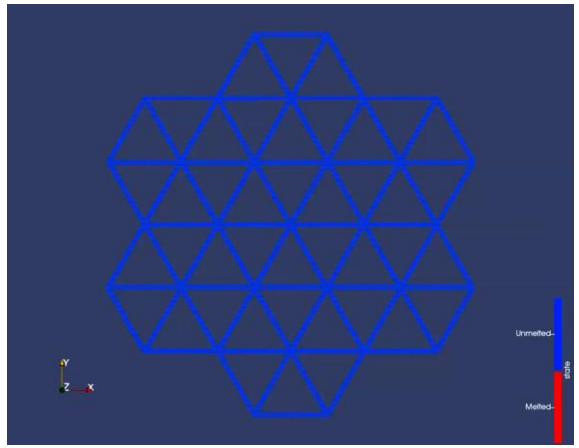
Scan strategy optimization for microstructure control

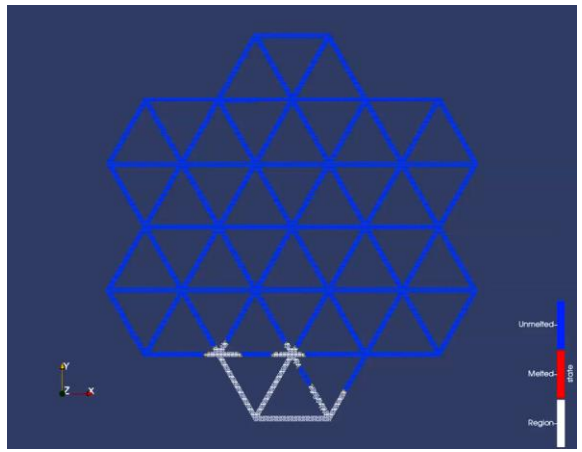
Understand limitations of current scan strategies

Develop fluid mechanics lower order models scaling to full parts

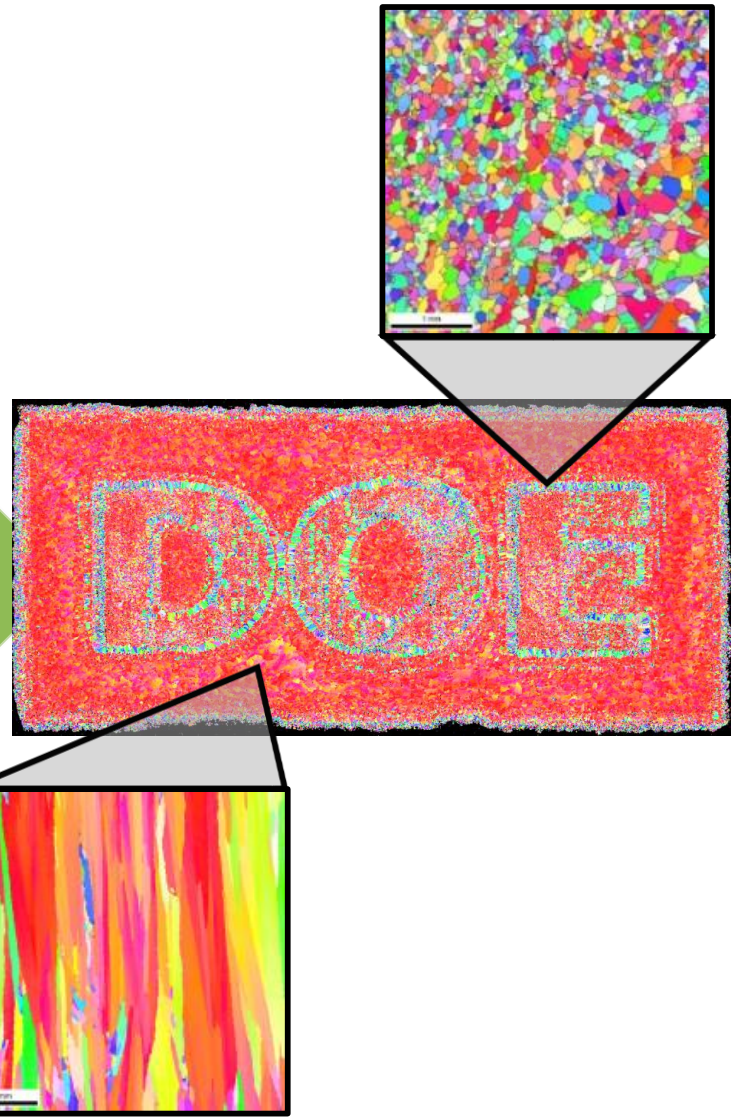








Optimize scan strategies to control thermal gradients



Questions?

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